THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VIII.—No. 179.

LIGHTNING CONDUCTORS.

Now that the summer season is coming on, the usual sensational accounts of accidents caused by thunder storms occupy conspicuous places in both the ordinary daily papers and also in those of a scientific nature. That the damage caused by lightning is very considerable is unquestionable; indeed, the records which already exist make a very fair show, although those of an early date are necessarily of a very imperfect and meagre character. Within the last few years the accounts of the destruction effected, and lives lost, have been very numerous; not that more damage has been effected recently than formerly, but more scientific interest has been taken in the subject, and, consequently, the information gained has been more considerable. Although many scientific men have ventured to give an opinion that protection from lightning need not be made local—that is to say, they consider that, by a judicious distribution of protectors over particular areas of ground, whole tracts of country may have every square foot protected from lightning, yet such a scheme does not seem likely to meet with much support, at least, for some time to come. Local protections of particular buildings, which seem to be more than ordinarily exposed to damage by lightning, is at present all that is considered necessary.

Our foreign neighbours, at a comparatively early date, appointed more than one committee to thoroughly consider the whole question of the protection of buildings from lightning, yet but little, if any, notice seems to have been taken in this country of the reports issued. The independent work of the late Sir William Snow Harris, although very practical, has hardly produced more effect. The fact that two reports were issued by the foreign committee, the latter of the two, in many points, completely cancelling the opinions expressed and laws laid down in the former one, seems to be almost unknown even to the best electrical authorities in this country. One cannot take up even the most recent text books on electrical science without finding the statement still adhered to, that a lightning rod will effectually protect a space contained beneath a cone, the radius of whose base is equal to that of twice the height of the rod. Now, any reader who will take the trouble to examine the second report referred to, will find it most distinctly stated, that the theoretical considerations upon which the theory was founded, and which were accepted as being correct by the first committee, are absolutely without foundation.

We have not the reports before us, but we fancy that the theory that solid rods are not so effectual as an equal weight of metal in the form of a tube, or a flat band, is still adhered to, though the practical data upon which the supposition is founded are devoid of existence. It is somewhat curious that some simple experiments have not been made to clear up this point to the satisfaction of all interested in the subject. In our own opinion we cannot conceive what sufficient reason can be given to warrant the idea that bands or tubes conduct the discharge better than a solid rod. The fact of a static charge existing only on the surface of a body has nothing to do with the question. We trust that the Lightning Protector Conference which was appointed some time ago by several scientific and learned societies, and which has, we believe, held numerous sittings and collected a large mass of evidence, will solve this and other knotty points; though, even if they do so, it will take a long time, we fancy, to make the weight of their authority effectually felt.

THE FIRE ALARM SYSTEM OF THE EXCHANGE TELEGRAPH COMPANY.

THIS system, which is being tried in several of the London streets, is very similar to the American plan which is so extensively adopted on the other side of the Atlantic. The American apparatus in its simplest form consists of a handle contained in a box, at any convenient part of a street. This handle on being drawn forward releases some mechanism in train with a circuit interrupter which makes and breaks the continuity of the line wire by definite periods, corresponding to numerals of the Morse alphabet. At the receiving or fire station a registering self-starting Morse apparatus is placed in circuit with a battery. When the alarm handle is in its normal position the circuit is closed and the Morse armature continually held down. By pulling out the handle and then releasing it the circuit interrupter referred to works and thus indicates on the Morse apparatus the number of the alarm box at which the handle has been pulled. An alarm bell is connected to the Morse to give notice of its working.

The system of the Exchange Telegraph Company is similar to the foregoing, but contains several important improvements which render its action highly efficient and satisfactory.

The general plan of the apparatus is shown by

figs. 1 and 2.—Fig. 1 representing the transmitter, and fig. 2 the receiver.

In fig. 1, H is the alarm handle which is pulled forward to the end of its stroke and then released when an alarm has to be sounded. The end of the stalk of this handle (which slides in guides) has a pin against which the arm, *n*, normally rests. This arm is in gear with the wheel, W, by means of a ratchet wheel and pawl. W is in gear with a train of wheels, which latter are also in gear with the circuit interrupting wheel, C. A strong mainspring has one end connected to the arm, *n*, and the other end to the wheel, W. The arm, *n*, in fact exactly corresponds to the winding-up key of an ordinary train of clock-work, except that it is not rigidly fixed to the winding-up axle but turns loose on it; it rotates the axle however, when drawn round to the right, by means of a pin fixed on to the axle and against which the lower end of the arm presses. Thus *n* on being drawn forward will act like a key winding up the spring; but on being released will move back, under the influence of a small spring, to the position shown in the figure, thus leaving the mainspring wound up.

Now, on drawing the handle, H, forward, the arm, *n*, is rotated to the right by means of the pin at the end of the handle stalk. When the handle is drawn to its extreme limit, the lever, *n*, escapes from the pin and falls back, thus leaving the mainspring wound up. If the handle, H, is now released, it moves back under the influence of a spring connected to it, and then, when it has come back to the limit of its stroke, it moves the arm, *n*, a little back, and the pin escapes over the top of *n*, and thus comes back to the position shown in the figure.

The mainspring being thus wound up and free to actuate the train of wheels connected to it, causes the cam wheel, C, to be rotated. In order to check the rate of rotation of C, one of the wheels of the train has on its axle a ratchet wheel and anchor escapement, the movement of this latter, as is well known, being necessarily slow, the required slowness, and also uniformity of motion, is obtained.

Into the teeth of the cam wheel, C, a projection in the lever, *h*, drops; this projection, when C is rotating, causes *h* to oscillate up and down once for each tooth on the cam wheel. Now, if C has all its teeth complete *h* will oscillate continually, and will break contact at *p*, thus producing contacts corresponding to a series of continuous dots. If, however, some of the teeth be broken away, say, every third tooth, then a series of discontinuous oscillations of *h* will be produced, which will correspond to dots in series of three; that is to say, three dots will be sent, then an interval, then again three dots, and so on.

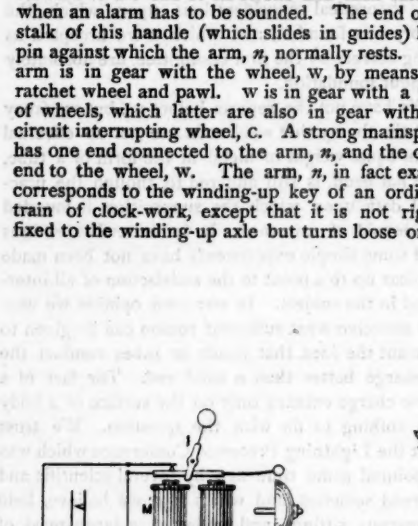


FIG. 1.

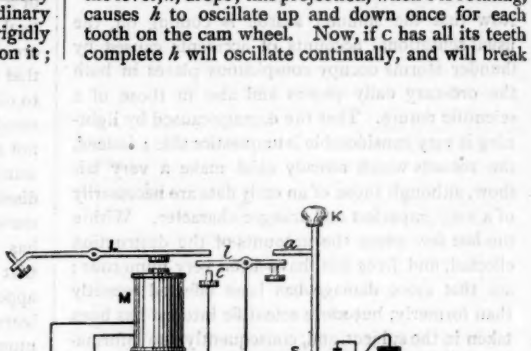


FIG. 2.

The contact point, *p*, it will be seen, is connected to "line." The axle of lever, *h*, is connected to one end of the electro-magnet, M_1, of an ordinary trembling bell. The lever is also connected to a straight spring, s_1, which on being pressed forward makes contact with the spring, s. Between s and s_1, a resistance, *r*, is fixed whose value is about equal to that of the electro-magnet, M_1. Finally,

S_1 and the contact spring of the trembling bell are connected to earth.

Between the poles of the electro-magnet, M_1, a steel magnetised tongue with an indicating tablet, I, is placed, the current through the electro-magnet, M_1, will then move the tablet to one side or the other, according to the direction of the current. Normally the position of the tablet is such that it is not visible to the eye, but when a reversal is sent through M_1 it moves over opposite an opening in the case of the transmitter. The whole transmitting apparatus is inclosed in an iron case with a door. This door when shut presses the two springs, S, S_1, together, thus putting the lever, *h*, direct to earth.

We will next consider the receiving portion of the apparatus. R is a relay, whose tongue, *b*, is normally held over by the current against an insulated contact. When the current ceases, *b* moves against its other contact, closing the circuit of the self-starting Morse embosser, M, and its local battery and single stroke bell, B'. At the end of the lever, L, of the Morse is a smaller lever, *l*, which, when its left arm is depressed against contact point *c* by L being pulled down, closes the circuit of the trembling bell, B, and its local battery. S is a reversing switch which is held normally in one position by a spring. To this switch is connected the line battery, E. Thus normally a continuous zinc current flows out to line, the circuit of the battery being complete to earth through the relay, R. K is a small knob fixed to the top of a vertical stalk, which stalk is connected to the switch, S. A small arm, *a*, is fixed to K. This arm projects over the right arm of lever, *l*, so that if K be depressed, *l* will be pushed to the position shown in the figure. The depression of K at the same time actuates the switch and reverses the line current. The action of the whole apparatus will then be as follows :—

The current from E being continually flowing to line, the tongue, *b*, of the relay, R, is held over against its insulated contact ; this current flows through the contact point, *p*, of the transmitter (fig. I), and thence through the lever, *h*, and the two springs, S, S_1 (which are pressed together by the door being shut), to earth.

Now, on opening the door of the apparatus, S, S_1 become separated, and a portion of the current flows through the resistance, *r*, and the other portion through the electro-magnet, M_1, of the trembling bell, which it rings ; the tablet, I, is not affected, as it is only held harder over in its normal position.

If the handle, H, is now drawn out and released, the cam wheel, C, is set going, and sends the series of intermittent contacts or sets of dots. As the circuit is partially complete through the resistance, *r*, the intermittent breaks caused by the ringing of the bell, M, do not interrupt the continuity of the circuit.

At the receiving station, the relay, R, is actuated by the intermittent currents, and works the Morse embosser, M, at the same time sounding the single stroke bell, B^1, thus both audible and visual signals are given.

The first movement of the lever, L, depresses the end of lever *l* against the contact point, *c*, and leaves it there. The bell, B, is thus set ringing.

As soon as the alarm is heard and the instrument has ceased working, the person in charge of the instrument depresses the knob, K, thus raising the lever, *l*, off its contact stop, *c*, and stopping the bell, B. The depression of K also actuates the switch, S, thus reversing the line current ; the effect of this is to move the indicator, I, over to the position which renders it visible, thus notifying to the sender of the signal that his alarm has been received.

It is evident that any number of transmitters may be joined in the same circuit, each transmitter having its cam wheel teeth arranged in a different way. The earth connection is, of course, only used at the terminal station.

The teeth on the cam wheel are so arranged as only to send "dots," no "dashes" are used, but the dots are arranged in different combinations for different stations. In any case, the sets of signals are repeated three times by the cam wheel.

IMPROVED LIGHTS FOR LIGHTHOUSES.

A SUMMARY of the opinions of the lighthouse authorities on Sir William Thomson's proposals for reform in the present system of lights* has been printed in the *Architect*. It appears that the Committee of Lloyd's, immediately after the letter was published, wrote to the Board of Trade, stating that they considered Sir William Thomson's idea that each lighthouse should furnish some distinctive mark by which it may be recognised, and not confounded with any other, was well worthy of consideration. The Board of Trade accordingly formally brought the subject under the consideration of the authorities having charge of lighthouses in England, Scotland, and Ireland, and in due time reports were returned to the Board.

Messrs. D. and T. Stevenson, the engineers to the Board of Northern Lighthouses, in their report, say that the essential principle of the simple lighthouse characteristics at present in use is that of optical distinction and strongly marked, and, therefore, obvious differences in the periods of light and darkness, while the proposed system consists of intricate and minutely different numerical distinctions in number and order of eclipses crowded into very short periods. The origin of such schemes as that of Professor Babbage and Sir William Thomson is, according to Messrs. Stevenson, an erroneous idea regarding facts which are well established. There is a current and widely diffused, though wholly unfounded, notion that the great cause of shipwrecks is the mistaking of one light for another by the mariner. Mr. Alan Stevenson, in 1851, showed, by statistics of the Scotch coast for four years, that the real cause of shipwrecks at night was not by the mistaking of one light for another, but rather the non-visibility of the lights. Out of 203 shipwrecks occurring in these four years, 133 occurred by night, and in only two of these was it ever alleged that the appearance of the light had not been recognised, and in only one of these two cases were the lights specified that were alleged to have been mistaken for each other, viz., the re-

* *See Telegraphic Journal*, December 15th, 1879, p. 407.

volving light of Inchkeith for the fixed light of the Isle of May. The grand requisite of all sea lights is penetrative power, and not a great variety of characteristics, *i.e.*, by appearances at once appreciable by the eye, or else by broadly marked variations of periods, and not by minute differences exhibited in rapid succession indicative of certain letters of the alphabet, which could only be read by people trained to such a system of telegraphy, or the modification of this system now proposed by Sir William Thomson. Messrs. Stevenson, in conclusion, say that the system of altering all fixed lights to the dot and dash, or Morse alphabet, system would, from the minute differences in characteristics, lead not only to perplexity in the mind of the sailor, but, they fear, to disastrous results; and that such a mode of distinction, though it were free from danger, is uncalled for because unnecessary.

The Elder Brethren of the Trinity House also declined to recommend the adoption of the Morse alphabet as being superior to the methods now in use, or better adapted to the comprehension of every grade of maritime intelligence. It is believed, they say, that if each light of the whole cordon round the coast were taken *seriatim*, there is not one whose identification could not be secured by observations far rougher and less minute than would be required for determining the existence and the sequence of longs and shorts.

The Commissioners of Irish Lights were found to be less inimical to the new system than any other authorities. It would be injudicious, they believe, to adopt the dot and dash system generally, but the group flashing system could be applied with advantage to those lighthouses on the Irish coasts by which the transatlantic vessels shape their courses. It would be of incalculable use to the masters that, on first making land, either in dark or foggy weather, they should have an unmistakable defined light. The Commissioners point out the concurrence of opinion between their scientific adviser, Dr. Tyndall, and Sir William Thomson. Dr. Tyndall said that it would be easy to give every lighthouse supplied by gas so marked a character that a sailor should recognise it with infallible certainty, and in carrying out his recommendations the Commissioners were very early impressed by the extraordinary facility with which, by the simple turning on and off of gas at any required interval, distinctive variations, to almost any extent, might be made in lighthouse lights, without impairing in the slightest degree the great penetrative power of the light itself. So far back as 1867 they applied this system to Wicklow-head, where, by a very simple piece of clockwork, the light is turned on and off, so as to cause a light of ten seconds and an interval of darkness of three seconds' duration; and in 1871 at Minehead the same principle was adopted with fifty seconds light and ten dark. The use of gas in other lighthouses was recommended; and in 1877, with the approbation of the Board of Trade, the Commissioners placed at the new lighthouse at Galley-head a group flashing gas-light, which was lighted in the following year, and is now, they believe, the most striking example in the world of this kind of light, the flashes of the powerful quadriform revolving light at that station being broken up into groups, producing an effect of unrivalled individuality. This system of group-flashing is capable of almost endless variations.

Sir William Thomson's other suggestions have been received by the experts with more favour. The advantage of coloured lights at important points is no longer insisted on, and Messrs. Stevenson acknowledge that use of colour is attended with disadvantage, not only to men who are colour blind, but to all mariners in foggy weather, when the white lights acquire a reddish hue, so as to stimulate the effect produced by red shades.—*Journal of the Society of Arts.*

DUPLEX TRANSMISSION WITH TWO RELAYS.

By M. KOVACEVIC, Secretary of the Telegraphic Administration at Agram.

THE employment of two relays for duplex transmission has for its object the avoidance of the necessity of establishing equilibrium, an indispensable condition with a single relay, and to give the means of obtaining duplex or diplex transmission without other means than those which are required for ordinary simple working.

It is possible to obtain this object in different ways, and the arrangement depends upon the disposition of the batteries, that is to say, whether like or unlike poles are put to earth at the two stations.

I.

Arrangement of Terminal Stations.

Fig. 1 shows the arrangement to effect duplex working in the first of these two cases, that is to say, when the batteries at the two stations have similar poles to earth, and when, consequently, the poles act against one another. The transmitting keys are of the ordinary kind, having their axes connected to the two relays of each station, and the working contacts to the batteries, of equal power, B_I and B_{II}, and to earth.

R_I and R_{II} are neutral relays, which can, however, be also polarised relays. The relays, P_I and P_{II}, on the contrary, must necessarily be polarised so that they may be acted upon only by the current coming in through the line, W, and not by a current going out to the same.

The figure shows clearly how communication is established with the local batteries, L, and the Morse writers, M_I and M_{II}, by means of the relays, P_I and R_{II}, on the one hand, and the relays, P_{II} and R_{II}, on the other. The closing of the local batteries and, consequently, the production of signals on the Morse writers can only take place when the armatures of the polarised relays remain in contact with the screws, u_{II}, and when, on the contrary, the levers of the neutral relays are in communication with the lower screws, v_I.

The condition indicated in the figure is the state of repose, during which the batteries, of equal power, B_I and B_{II}, which communicate with earth by their negative poles, send their positive currents out to the line, W, or produce a neutral effect.

The levers of the neutral relays remain free, and rest in contact with the lower screws, v_I, whilst the

armatures of the polarised relays establish communication with the screws, u_1.

In this case, neither of the Morse writers produce signals, the circuit of the local batteries, L, not being closed.

If the station, I, depresses his key, the positive current of the battery, B_1, passes through the relay, R_1, and returns by the point, *a*, to the negative pole, by the axis and the working contact of the lever of the depressed key.

The resistance of this latter path of departure by the point, *a*, which can be formed of short and thick iron wires, being nil, it does not produce any bifurcation, and, consequently, it does not allow any of the current of the battery, B_1, to pass out to the line, W.

The relay, R_1, at the station, I, which sends signals, works when its lever is moved away from the screw, v_1, and goes over to the screw, v'_1. The Morse printer, M_1, produces then its proper signal, if the armature of the polarised relay, P, remains in contact with the screw, u_1, but such is not the case, as will be seen.

By the fact of the introduction of the battery, B_2, in the closed local circuit, the battery, B_2, of the station, II, is the only one which works to line. Its positive current passes through the two relays, R_2 and P_2 of the station, II, by the line, W, the polarised relay, P_2, of the station, I, from whence it arrives at the point, *a*, by the lever of the key at the station, I, which has been depressed, and by this means goes to earth. The relay, R_2, comes into action when its lever leaves the screw, v, and makes contact with the screw, v_2. On the other hand, the polarised relay, P_2, does not work, for the northern magnetism being increased in the lower coil and increased in the upper coil, the contact of the armature of the relay with the lower screw, u_2, is only made stronger.

The local battery, L, has its circuit closed through the medium of the levers of the two relays, P_2 and R_2, and thus the Morse writer, M_2, reproduces the signal sent out by the station, I.

The positive current of the battery, B_2, which goes through the polarised relay, P_2, of the station, I, increases the northern magnetism in the upper coil, whilst it decreases it in the lower coil. The armature of this relay leaves then its contact with the screw, u_1, and that before contact is established with the screw, v_2, of the relay, R_2, when the key is depressed.

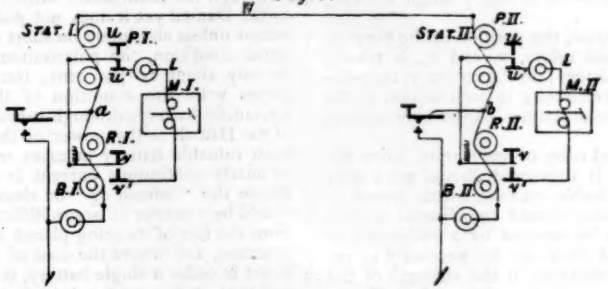
The circuit of the local battery, L, of the station, I, remains open, and consequently, the Morse writer, M_2, does not reproduce the signals.

The same thing occurs when station II depresses his key whilst the key of station I remains in its normal position. As, in this case, the current of the battery, B_2, is the only one which goes out to line, the relay, R_2, comes into action while P, remains inactive. The local battery, L, of the station, I, is then closed, and the Morse writer, M_2, reproduces the signal sent out by station II.

When the positive current of the battery, B_1, which goes out to line, has broken the contact of the armature of the polarised relay, P_2, with the screw, u_2, the circuit of the local battery, L, of the station II becomes open, although the relay, R_2, of that station works by its own current, which finds a closed local circuit from the point, *b*, through the depressed key.

If the two stations depress their keys, the relays R_1 and R_2 are worked by their own currents introduced in the local closed circuit.

Fig. 1.



The polarised relays, P, and P_2, not being, at this moment, acted upon by any current, their armatures continue resting against their contact screws, u; and in consequence, the circuits of the local batteries are closed and the Morse writers respond.

If the station, I, allows his key to return to its normal position, his Morse writer continues to work, the levers of the relays, R, and P_2, remaining in contact with the screws, v, and u_1. On the other hand, the signals sent out by the station, I, cease to be reproduced by the Morse writer, M_2, for the contact of the tongue of the relay, P, with the screw, u, becomes then interrupted by the current of the battery, B_2, coming to line, and the circuit of the local battery, L, becomes opened.

If the station, II, also allows his key to come back to its normal position, the effects of the currents from the batteries, B, and B_2, neutralise one another and produce again the state of rest which has been previously referred to, and therefore the station, I, ceases also to reproduce the signals emitted by the corresponding station.

If leakages or changes of resistance occur on the line, the effects of the currents are only to produce partial compensation, and each section of the line

remains influenced by the part of the current which is not compensated for by the current sent out to line by the battery in that particular section.

If the amount of the leakage, &c., is such that the neutral relays, R, and $R_{,,}$ do not produce signals in their normal condition of affairs, the correct working of the duplex principle is still assured.

If, however, the changes are such that one or other of the neutral relays can produce signals even in their normal condition, then ordinary single working only will be possible for either station, since the case becomes practically one of ordinary working with reversed currents.

In this case the realisation of duplex transmission has, naturally also, reached its extreme limit.

In order to be able to obtain then simple working, and also, consequently, duplex transmission, it will be necessary to regulate one or other of the neutral relays, R, and $R_{,,}$ or even both of them, so that the tension of their springs is sufficient to cause contact to be re-established by their tongues with the upper screws, *v*.

This regulation, which is easily obtained by means of the counteracting springs, gives the means of obtaining not only ordinary working, but also duplex transmission, and, as can easily be understood, duplex transmission is subject to the same conditions which allow of ordinary single working being effected.

In the state of repose, the position of the tongues of the two polarised relays, P, and $P_{,,}$ is wholly uninfluenced by leakages; on the contrary, the position of the current remaining in each section of the line simply holds the armatures harder over against the screws, $u_{,}$.

Since the polarised relay of one station, when the key at that station is depressed, should work from the comparatively feeble current which comes in from the line, this relay should be adjusted in such a way that it can be worked by a minimum of power, for it would then not be necessary to re-adjust it after each variation in the strength of the current which is caused by leakages, &c.—*Translated from Annales Télégraphiques.*

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XIII.

THE DUPLEX SYSTEM—(*continued*).

THE actual form of switch for changing from duplex to single working or *vice versâ* is shown by fig. 59. The same form is used both for direct and for relay working.

BATTERIES.

Having in the last twelve articles considered the principal forms of hand-worked instruments employed in the British Postal Telegraph Department, it is now proposed, before proceeding further in the description of the apparatus, to draw attention to the various forms of batteries employed to work the same. At the present time there are three descriptions of batteries in use, viz.: the Daniell, the Bichromate, and the Leclanché; each kind has its special value, which experience has pointed out.

The Daniell which, as is well known, is the oldest description of battery, has been made in several forms, but the essential principle is the same in all. Its great point of utility consists in its being able to give a constant current under all conditions, that is to say, whether it be worked through a high resistance, or on practically short circuit. The electro-motive force, or power of overcoming resistance of the Daniell per cell may, for ordinary purposes, practically be taken as unity or 1.

The Bichromate battery, which is now largely used for telegraphic purposes, is, in principle, an old invention; it has, however, been so modified that its employment, which was discontinued after trial some years ago, has been revived, and with excellent results. The author of these improvements is Mr. John Fuller. The great advantage of the Fuller battery lies in its high electro-motive force, which is practically double that of a Daniell. The internal resistance of the cells, owing to the high conducting power of the fluids used in them, is also very low; this latter fact enables a strong current, under certain conditions, to be given, when batteries of a high resistance will not do so. Although the Bichromate battery is not as constant as the Daniell yet it does not *polarise* to any great extent unless absolutely on short circuit; under the latter condition, the polarisation in 1 minute may be only about 10 per cent., but this latter value varies with the condition of the battery. The Leclanché battery, although it has not the constancy of the Daniell or the power of the Bichromate, is a most valuable battery in cases where a continuous or nearly continuous current is not required, and where the "refreshing" or cleaning of a battery would be a matter of some difficulty and expense, from the fact of its being placed at stations difficult of access, and where the cost of a special journey to set in order a single battery, it may be, would be a heavy item compared with the value of the message work done. The electro-motive force of the Leclanché battery is about 1·6 that of a Daniell, or, in other words, 10 Leclanché cells will give about a similar electro-motive force to 16 Daniells. The battery when not in use does not waste to any appreciable extent, or, in other words, is almost entirely free from "local action;" this is not the case with the Daniell and Bichromate batteries, which, if left to themselves for any considerable length of time will become exhausted, although no current is generated; this local action, however, probably ceases when the batteries are working, that is to say, the whole of the material consumed goes towards producing the current.

If we take a vessel containing a solution of sulphuric acid and water, and place in this a rod or plate of either pure zinc or zinc which has been amalgamated with mercury, then no action or change will be observed on the metal; and, further, if a plate of copper be likewise immersed in the liquid no action or change will take place on either metal provided the two do not touch. If, however, the metals be connected together by a short piece of wire, then bubbles of gas will be copiously given off from the copper or platinum plate, and at the same time the zinc will be attacked by the acid and

FIG. 61.

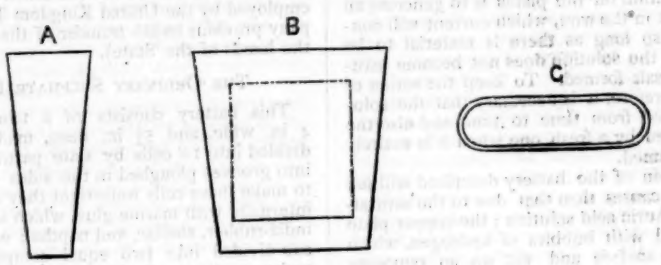


FIG. 59.

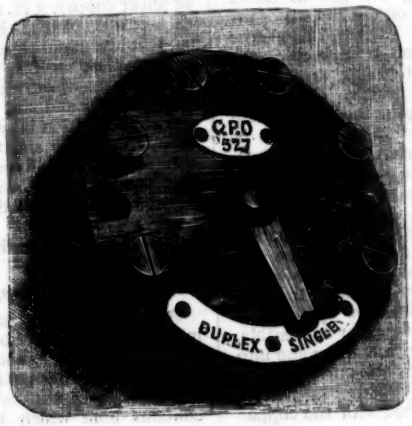
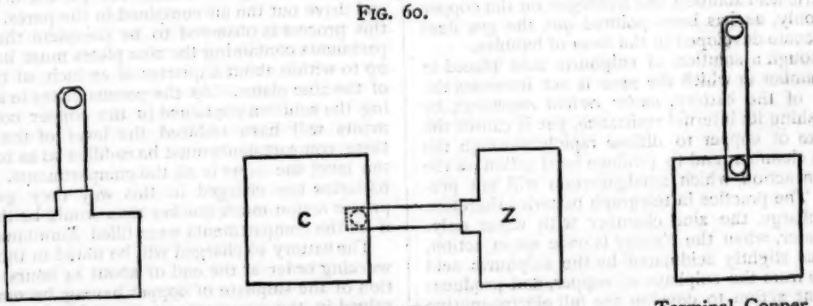


FIG. 60.



Terminal Zinc. Pair of Plates. Terminal Copper.

gradually dissolved, the combination of the zinc with the acid forming the salt sulphate of zinc. This action will continue as long as the plates remain connected together, but will cease immediately the wire joining them is severed. The result of the action on the plates is to generate an electric current in the wire, which current will continue to flow so long as there is material to be consumed, and the solution does not become saturated with the salt formed. To keep the action of the cell up, therefore, it is necessary that the solution be renewed from time to time, and also the zinc be replaced by a fresh one when it is entirely or nearly consumed.

The full action of the battery described will fall off from other causes than that due to the saturating of the sulphuric acid solution; the copper plate becomes coated with bubbles of hydrogen, which adhere to the surface and set up an opposing action.

DANIELL'S BATTERY.

To get rid of the effect of the hydrogen, Daniell conceived the idea of causing the gas to throw down a deposit of pure copper on the surface of the copper plate, thus not only getting rid of the *polarising* action but at the same time keeping the surface of the plate clean and bright, so that the flow of the current is not impeded. This object was completely effected by keeping the copper plate immersed in a saturated solution of sulphate of copper, the hydrogen in this case instead of adhering to the plate, decomposed the sulphate of copper, and deposited pure copper on the surface of the former.

As it is necessary that the zinc plate be immersed in the sulphuric acid solution and not in the sulphate of copper, since the latter would be decomposed locally by contact with the zinc, the two liquids are separated from each other by a porous material, which, while it prevents, as far as possible, the mixing of the liquids, allows them to come into actual contact, and thus enables the current to be conducted between them.

The action of a cell constructed with the copper plate in a solution of sulphate of copper contained in a porous vessel, and the zinc in a solution of sulphuric acid, is similar to that of the simple one first described, sulphate of zinc being formed in the sulphuric acid solution and hydrogen on the copper plate, only, as has been pointed out, the gas does not become developed in the form of bubbles.

Although a solution of sulphuric acid placed in the chamber in which the zinc is set increases the power of the battery, *under certain conditions*, by diminishing its internal resistance, yet it causes the sulphate of copper to diffuse rapidly through the porous chamber, and to produce local action on the zinc, an action which amalgamation will not prevent. The practice in telegraph batteries therefore is to charge the zinc chamber with water only. This water, when the battery is once set in action, becomes slightly acidulated by the sulphuric acid set free from the sulphate of copper, and produces sufficient action to develop the full electro-motive force of the battery, though the internal resistance of the latter is higher than would be the case if the acid were used; but the value of this resistance is not so great as to materially affect the strength of the current which the battery is required to give out.

There are three kinds of Daniell's battery at present in common use, viz., the *Ordinary*, the *Chamber*, and the *U. K.* (so-called from its being employed by the United Kingdom Telegraph Company previous to the transfer of that company into the hands of the State).

THE ORDINARY SULPHATE BATTERY.

This battery consists of a trough 2 ft. long, 4 in. wide, and 5½ in. deep, made of teak, and divided into 10 cells by slate partitions, which fit into grooves ploughed in the sides of the trough; to make these cells watertight they are well coated internally with marine glue, which is a mixture of india-rubber, shellac, and naptha; each cell is then sub-divided into two equal compartments by a porous partition of white unglazed porcelain, ¼ in. thick; these partitions are fixed in position whilst the coating of marine glue is hot. The zinc and plates for the cells are 3½ in. wide and 2 in. deep; these are connected by a copper strap to a plate of sheet copper, 3 in. square; the copper strap of each pair of plates is bent over the slate partition, so that the zinc plate hangs in one cell and the copper plate in the contiguous cell. A pair of plates is fixed astride of each slate division, so that a copper and zinc plate face one another with a porous partition between throughout the trough. The last copper and the last zinc plate are each connected to brass binding screws or terminals, the copper plate being connected to the left-hand terminal and the zinc to the right-hand terminal of the trough.

The exact form of the battery plates will be seen from fig. 60.

To charge the Battery.

About 3 oz. of sulphate of copper crystals, which must be in lumps of about the size of hazel nuts, are placed in the compartments containing the copper plates, and the former are then filled with *soft* water (hard water should never be used, as it contains lime which incrusts the zincs and the porous partitions, and stops the action of the battery) up to a level with the top of the zinc plates. A little time must then be allowed for the liquid to thoroughly saturate the porous divisions, and drive out the air contained in the pores. When this process is observed to be complete the compartments containing the zinc plates must be filled up to within about a quarter of an inch of the top of the zinc plates. As the porous plates in absorbing the solution contained in the copper compartments will have reduced the level of the liquid these compartments must be re-filled so as to make the level the same in all the compartments. When batteries are charged in this way they get into proper action much quicker than would be the case if all the compartments were filled simultaneously.

The battery so charged will be found in thorough working order at the end of about 24 hours, a portion of the sulphate of copper having become dissolved in the compartment in which it is placed, and sufficient having passed through the porous partition into the zinc chamber to start the chemical action.

If the battery is required for immediate use it

may be started at once into good action by placing a weak solution of sulphate of zinc in the zinc compartment. It is a common practice to obtain this solution by taking a portion of the liquid from the zinc chambers of batteries which are in full action, and placing it in the cells, which are then filled up with water. Care must be taken that the zinc plates of the battery do not touch the porous partitions, as this causes metallic copper to become deposited on them.

The solution in the zinc cell must never be allowed to become saturated with sulphate of zinc, as this stops the action of the battery by causing crystals to form on the zinc plate. Crystals are also liable to form on the tops of the plates and edges of the trough; these should be wiped off when they form, by means of a damp cloth, otherwise the liquid in the cells will be drawn off by the capillary action of the salt.

Some crystals of sulphate of copper must always be kept in the copper cell, otherwise the action of the battery will cease, owing to zinc instead of copper being deposited on the copper plates. When a sulphate battery is cleaned, the zinc plates should be scraped to remove the deposit of copper which always adheres to them; the plates need not be removed for this purpose, as only the side of the zinc facing the porous partition gives action in the battery.

Owing to the action of the current, and from other causes, the liquids in the cells often become unequal in level, the solution filling one cell completely, and leaving the neighbouring one half empty; an occasional syringing out is necessary to prevent this.

Besides being tended constantly, the battery must be thoroughly cleaned every two or three months, according to the work it has been doing. The solution in the zinc cell is first drawn off by a syringe, and placed in a jar in which a few scraps of zinc are placed, to throw down any copper which may be contained in the solution; this solution is used for recharging the batteries after they are cleaned. The liquid in the copper cell is similarly drawn off and kept. The crystals of sulphate of copper are next removed, and then the plates are taken out, and well scraped and cleaned, the mud removed being kept for sale. The porous partitions are then cleared of copper, and the cells finally well washed out with clean water.

The "Ordinary" sulphate battery, although it is at the present time extensively used, has the great disadvantage that, if any of the porous partitions become broken, they cannot be replaced without the whole battery being dismantled. It is difficult also to make the porous partitions sufficiently strong without making their resistance high. For these, and other reasons, this form of battery is now practically obsolete, and is being superseded as quickly as possible by another pattern.

THE CHAMBER BATTERY.

This form of battery, like the foregoing, is also extensively used. The cells are made in pairs, and consist, first, of a square chamber of white glazed porcelain, 5 inches square, and 5¾ inches deep; this chamber is divided into cells by a partition of the same material. Into each cell is placed a porous earthenware pot of the form shown in side, front, and top view, by A, B, C, fig. 61, respectively. The top, sides, and bottom of these pots are dipped in hot paraffin wax, as shown by the dotted lines in A; the back is also similarly coated, thus only the portion of the pot opposite the zinc plate is left porous. This prevents the diffusion of the sulphate of copper through the pores into the sulphate of zinc solution, except at the part opposite the zinc, where it cannot be prevented. Recently ozokerit has been used in the place of paraffin, and with success, as it is not so brittle as the latter substance.

In this porous pot the sulphate of copper and the copper plate are placed. The size and arrangement of the plates, and the mode of fitting, charging, and maintaining the battery, are precisely the same as in the "Ordinary" battery.

Five of the porcelain chambers, forming ten cells in all, are placed in a wooden box, 2 feet 2 inches long, without partitions. In many places this box is dispensed with, and the chambers are simply ranged on shelves or racks in the battery room, and are covered over by hinged covers forming part of the rack itself.

As compared with the "Ordinary," the "Chamber" battery offers extra facilities for cleaning and repairing; imperfect cells and porous pots can obviously be replaced with the greatest facility.

Notes.

A SOMEWHAT curious communication has been recently made to the Academy of Sciences, Vienna, by M. Exner. This gentleman announces that if a bismuth and antimony thermo-pile pair be plunged into a gas which has no chemical action upon either of the metals, then heat applied at the junction will not cause a current to be generated. If also two copper bars be joined together, and one be so protected that it cannot be acted upon, then if the pair be plunged into chlorine gas, which attacks copper, a current will be generated on applying heat to the junction; this is not the case if the two bars be both protected or unprotected.

THE SCANDINAVIAN PATENT OFFICE.—The following resolutions have been passed by the French and Danish Governments, dated 7th April, 1880, and likewise by the Government of the Kingdom of Italy, March 3rd, 1880, relative to the registration of trade marks and designs:—France and Denmark.—1st. "The Danes in France and the French in Denmark, shall enjoy, as regards the registration of trade marks and designs, the same rights and protection as the subjects of these respective countries themselves." 2nd. "Subjects of either of these two countries, desiring to secure to themselves the registration and sole right of their trade marks and designs in either or both of these two States, are bound to conform to the rules and formalities prescribed by law and in existence in these two contracting States." 3rd. "The resolutions explained in the above two articles are equally applicable to the trade marks and designs of any kind or nature whatsoever." 4th. "This arrangement, as above described, shall be executory immediately after its promulgation in the two countries, and shall continue in force for the term of one year after the rescinding of the resolution by one or other of the contracting parties." Italy.—The Court of Cassation of Turin, under date of March 3rd, 1880, has

sanctioned the following resolutions in regard to the law of the 30th August, 1868, concerning the registration of trade marks and designs, which is applicable and favourable to all foreign manufacturers. 1st. "When a mark or sign presents a similar character to any other symbolical characteristic, for example, the name and signature of the inventor, and the name of the place from whence the goods arrive, and to which the marks or signs are attached. A foreigner, who lawfully uses the same mark or sign in his own country, may also have the exclusive right to use the same in the Kingdom of Italy by conforming himself to the prescribed law, passed the 30th of August, 1868, regarding the registration of trade marks and designs." 2nd. "That any use of such a mark or sign, or the same being published and promulgated in the Kingdom of Italy previous to the obtaining of the necessary certificate of protection, shall be considered as a violation of the law, and no exclusive right to use any mark or sign will be guaranteed after such mark or sign has thus fallen into public hands." The result of the above resolution being that all foreign manufacturers or merchants who first register in Italy their distinctive trade mark or sign will be able to obtain the protection of the same by law, and a guarantee against any infringement whatsoever.

TELEGRAPH BUSINESS AT CHICAGO DURING THE REPUBLICAN CONVENTION.—The political telegraphing, especially during presidential elections, has become an important item in the aggregate of telegraph business done. The recent prolonged and excited National Convention of the Republican party at Chicago, gave active employment to all the telegraphic facilities which could be supplied, the amount of business done by the telegraph companies during the session of the Convention, and for two or three days previous to its assembling, greatly surpassing that of any similar gathering in the past. The Western Union Telegraph Company worked some fifty circuits from the Exposition Building, where the Convention held its sittings, all of which were kept busily occupied. On these circuits the company sent an aggregate of 300,000 words of matter containing the most important part of the proceedings, which were bulletined at about 6,000 of the company's offices for the benefit of the public, free of cost. In addition, there was an average of nearly 400,000 words sent daily to the press, or a total of 3,049,556 words of press reports, sent from May 29 to June 8, inclusive. Besides this there were 225,468 private messages sent, making a total of 7,858,916 words. At the Illinois Republican State Convention, which preceded the National Convention, and in which the interest was unusual and the excitement attending it very great, the work done by the Western Union Company was very heavy and very promptly and satisfactorily performed. The telegraph labour commenced May 16 and ended on May 22, thus lasting an entire week. The Convention proper was in session three days. The week's record shows the following handsome results:

	Words.
Special and associated press matter sent ...	215,925
Press matter received for delivery to the local press	38,208
Total press matter	254,133

Journal of the Telegraph.

Les Mondes states that M. Tommasi has recently been effecting improvements in his relay with the view to make it practically workable on the Hughes instrument through a submarine cable. The instrument has been made to work through a resistance considerably higher than that of the transatlantic cables, an achievement which is made the most of, but which in no way proves that the effect of inductive retardation will not cause interference.

M. BECQUEREL finds that in the cases of the diamagnetic gases, protoxide of nitrogen, carbonic acid, nitrogen, and olefiant gas, the amount of magneto-rotatory polarisation which rays of light undergo in passing through the same varies nearly in the inverse ratio of the square of the wave lengths as for non-magnetic bodies. Oxygen, a magnetic gas, acts differently, for red rays it gives a rotation which is a little above the green rays; in the case of the diamagnetic gases the reverse is the case, the rotations for green as compared with red being as 10 to 15.

THE Society of Slate Quarriers of Angers are adopting the electric light in their subterranean chambers in the place of gas. The plant comprises a 16 horse-power engine, 6 continuous circuit Gramme machines, a seven strand cable copper conductor 350 metres in length; the lamps are of the Serrin type. Taking each lamp as equal to 300 Carcel burners, the cost of lighting per hour is estimated at ·0037fr. for electricity and ·034fr. for gas.

THE Council of the Society of Arts have addressed a memorial to the Postmaster-General, asking him to reduce the tariff for inland telegrams by fixing the limit of charge at sixpence instead of a shilling, as at present. The memorial points out that, as regards cheapness of telegrams, England is behind several continental nations, and refers to the curious anomaly that a telegram can be sent for less money from any part of the United Kingdon to Belgium, than from one part of London to another. Between England and Belgium the charge for telegraphic messages is twopence a word, and, consequently, a telegram of four words (the sender's name, the receiver's name, the receiver's address, and a word for the message) can be sent for eightpence. Sufficient time has not elapsed since the sending in of the memorial to admit of a reply being received.

RESISTANCE OF MAGNETO-ELECTRIC MACHINES.—A paper was read by M. Carnellas on the 7th inst. before the Académie des Sciences, on the direct measurement of the interior resistance of magneto-electric machines in motion. The induction of the electro-magnets and the metallic cheeks is obviated by rotating the (Gramme) ring mounted carefully with its brushes on wooden supports, and the effects of terrestrial induction are avoided by opposing to each other these effects in two similar Gramme rings, mobile under the same conditions, with axles parallel. The ring (at rest or rotating) is made the fourth side of a Wheatstone bridge formed by Siemens' universal galvanometer. The resistance of the ring in motion (450 turns per minute) shows an increase of 25 per cent. on that of the ring at rest.

THE Bell Telephone Company of Canada held its first meeting at Toronto on Tuesday, June 1st. The company has purchased all the exchanges and business in Canada owned by the Dominion Telegraph Company, and is trying to purchase the Montreal Telegraph Company's telephone business. It has also purchased all the independent exchanges, including the Toronto Company.

THE PNEUMATIC TELEGRAPH IN PARIS.—Since the reduction of the charge for a single message by the pneumatic system, that is to say, since the first day of

last month, the number of messages sent has more than doubled. From some statistics published in Paris it appears that when a message has only to traverse a single section of the tube eight minutes are only expended, including the necessary office business appertaining to the message; for each section after the first five minutes more must be added, and as the great majority of messages pass through four sections the average time per message is equal to twenty-five minutes. There are, however, distances of eleven sections, and one, that from the Bastille to the Place du Trône, of twelve sections, and in the last case the journey occupies sixty-three minutes. Measures are now being taken to shorten, if possible, the time occupied by the passage of the cards through the tubes.

AT a recent sitting of the Académie des Sciences M. Reynier exhibited an improved voltaic battery. The new arrangement consists of amalgamated zinc in a solution of caustic soda, and a copper plate in sulphate of copper, the two solutions being separated by a rectangular vessel of several thicknesses of parchment paper. The electro-motive force of the new element is 1·3 to 1·5 volts, according to the concentration of the liquid. The couple can be regenerated by passing through it the current from a dynamo machine.

AT the same meeting of the Académie M. Ader presented a paper in which he gave the results of experiments proving that all bars of magnetic nature submitted to a mechanical action of compression, torsion, or traction, tend to recover their original molecular arrangement under influence of the magnetising current.

THE new Russian imperial yatch *Livadia* has been fitted up with eight Jablochkoff candles, under the superintendence of Lieutenant Rimsky-Korsakoff of the Russian Imperial navy. No less than sixty Jablochkoff candles will be ultimately in use.

AT Halifax, N.S., May 29, while divers were at work at Cole Harbour dike, a storm came upon them, and the lightning striking an air pump passed down to a diver under the water. When brought up he was insensible, but his injuries are not serious.

IT is said that the Western Union has appointed a special committee to equalise rates. Formerly reductions were made only to the large cities, and it is now proposed to equalise them, so that smaller and interior towns shall derive a proportionate benefit from each reduction. President Green recently said that the business of the company was never so good as now, and that there was an average of 4,000 more messages a day being received than during the same period last year.

Puck, the American *Punch*, thus expresses its opinion of Mr. Edison:—"Edison is not a humbug. Far from it. He is a man of a type common enough in this country—a smart, persevering, sanguine, ignorant, show-off American. He can do a great deal, and he thinks he can do everything. As a matter of fact, he is so smart that he is the tool of the first scamp that comes along. He would invent to-morrow, in perfect good faith, a three-legged stool. He would let speculators organise a stock company to float that three-legged stool. Then, when he found that three-legged stools were in common use before he was born, he would cheerfully go to work to invent something else, honestly unconscious of having done any mischief. That is just his position to-day. He has fussed and fumed over his electric light until he has made for himself every variety of failure that other men had made before him. Meanwhile, his Wall Street friends have put stock on the market, sold it at a high figure, and are now stowing away the difference between said figure and the present, which is somewhere along in the latitude of the Keely motor quotations. We acquit him of any complicity in all this. Mr. T. A. Edison probably hasn't a very delicate sense of commercial etiquette, but he is neither incompetent nor dishonest. However, if all this nonsense is being turned to bad account by dishonest people, it is Mr. Edison's business to protect the public from any wrong done them under cover of his reputation. And we fear there will some day be an exposure and an explosion that will make Mr. Edison feel particularly miserable. Let him see to it, that such misery is not deepened by remorse."

A FATAL accident occurred at a fire in Manchester through a fire-escape coming in contact with a telegraph wire attached to a chimney; the latter was pulled down and a falling portion killed a woman. It appeared at the inquest that the wire was one erected by a private firm, and was 22ft. from the ground. The jury returned a verdict of "Accidental death," and added a recommendation to the effect that, in consequence of this accident and the possibility of other accidents, all wires, whether private or public, should be put up at a height of not less than 35ft. from the ground.

A NEW Russian Electrical Journal, entitled *l'Electricité*, will make its appearance this month; it will be issued fortnightly, and edited by the sixth section of the Société Impériale Technique Russe, at St. Petersburg. The staff of the Journal includes several distinguished names. We wish our new contemporary every success.

THE present month also witnesses another addition to scientific literature. Under the excellent title of *Science*, a new American weekly periodical published its first number on July 3rd. It is difficult to judge from a first issue what success the new attempt will have, but the list of scientists who have promised their help augurs well for the future. The new production is of a somwhat similar class and uniform in size with our contemporary, *Nature*.

THE Silvertown Telegraph Works are now manufacturing an improved Poggendorff Bichromate Battery. The peculiarity of the new battery consists in the use of an improved bichromate compound, and also of a new exciting powder, which replaces the sulphuric acid generally used in this form of battery. The results obtained by the employment of these compounds is stated to be far superior to those derived from the use of other mixtures.

DR. STONE recently exhibited before the Physical Society an electro-magnet wound with the best charcoal iron wire $\frac{1}{4}$th in. in diameter, instead of the usual copper wire. The wires are wound on it in parallel circuits, and joined up for "quantity". It is stated that the lifting power of the magnet is four times as great as what would be obtained by the use of copper wire.

THE Russian company to work the Jablochkoff patent in Russia, with a capital of 5,000,000 roubles, and with the inventor as promoter, is, so says the paper *Molva*, not a success. M. Jablochkoff advertises that the money will be returned to the subscribers.

Review.

A Physical Treatise on Electricity and Magnetism. By J. E. H. GORDON, B.A. Camb., Assistant Secretary of the British Association. Two Vols. London: Sampson Low, Marston, Searle, and Rivington.

THE number of experiments that are being continually made by some of the most well known physicists, both English and foreign, is legion, and the apparatus for conducting the researches is often of a complicated and costly character. The records of the work done are decidedly voluminous and complete; but from this very fact it is difficult even for the most studious physicist to know what amount of discovery has taken place in any particular subject. Many branches of physical science have had the records of experiments made in those branches well described and illustrated in a concise form, but hitherto the records of electrical science have not been put into such a shape as has enabled workers to know what has been done. Mr. Gordon's new work is a step in the right direction to partially supply this want.

Considering that the experimental work has been carried on with elaborate and costly apparatus, it must be evident that a full description of the work executed, to be successful, must be carried out regardless of expense in illustration. This Mr. Gordon has done, and done very successfully, and he is to be congratulated upon the favour which his book has already met with. Over 250 illustrations—a very large number of which are whole page engravings, thoroughly well executed—in the two volumes show that neither pains nor money has been spared to make the undertaking as complete an exposition of the subjects treated on as possible.

The author states in the preface that "My object in this treatise has been to give a complete account of such portions of electrical science as I am acquainted with, and, at the same time, to regard them from a physical as distinguished from a mathematical point of view." "In order that the book may be more useful, I have entered very fully into the actual experimental details of most of the investigations mentioned, partly in order that any one wishing to continue the experimental investigation of the subject may find in the book accounts of what has already been done, and partly that students may see that electrical phenomena have a real existence, and are not merely abstractions or results of mathematical analysis."

In the first part of vol. I electro-statics are dealt with. In speaking of the "earth connection" it is pointed out that "Since in a body of small dimensions an induced charge on one end causes an equal but opposite charge to be induced on the further end, that if the body be connected to 'earth' the whole world becomes part of the conductor, the 'far end' being somewhere in Australia." This we consider to be quite a correct idea, though it is disputed by many. It is difficult to conceive that because a body is of very large dimensions it should not be subject to the same law which holds good for a smaller, the question is one of degree only. It is quite true that the conditions are such with a body of large dimensions that they may be *considered* as following a different law; but it is not true therefore to say that the theories in the two cases are not identical.

In dealing with problems of electro-statics for purposes of calculation, it is always advisable to have a clear notion of the nature of the thing with which we have to deal, although we may not know exactly what it is. If we attempt to explain what electricity is we may only confuse ourselves, especially if we bring the ideas into play when dealing with electrical problems. Mr. Gordon on this point says, "For purposes of calculation, electricity of either kind may be treated precisely as if it was a material or compressible fluid. It, however, differs from a fluid in the fact that equal quantities of the two kinds neutralise each other."

The transmission of electric force through space Mr. Gordon considers to be effected by a *strain* or distortion of the medium which fills the space between the electrified bodies. In the case of interplanetary space the ether is the medium, this medium having in itself no electrical properties. In speaking of lightning conductors, a proof, by Professor Ayrton, is given of the reason why pointed conductors enable a discharge to take place freely.

The idea of potential, which it is so hard to define clearly, is dealt with in the usual manner; that is to say, no attempt is made to define what potential is, but the way in which the term is used is pointed out. Passing on to electrometers, we find the various kinds of these instruments very fully and clearly illustrated, though instructions in the use of the apparatus are not given.

Chapter XI., on specific inductive capacity, is very full, this subject being, we believe, a favourite one with the author, whose own experiments are naturally dealt with at length. In these experiments, the substance whose inductive capacity is to be measured is not subjected to a continual charge, but to a rapid series of reversals, so as to prevent, it is thought, absorption; the whole apparatus used is very elaborate. The correctness of the method adopted is, we think, open to question, or, rather, we doubt whether greater accuracy is insured by it than by the ordinary methods. Professors Ayrton and Perry's investigations on the specific inductive capacities of gases are fully described, the conclusions arrived at being that gases differ very little in this quality, though differences do exist.

Part II. deals with magnetism, and for the first time, we believe, the beautiful instruments used at the Kew Observatory are described and illustrated. The description of the self-recording magnetometer is especially interesting.

Part III. describes the Voltaic battery. Considering the numerous theories that have been put forward relative to the protecting action of mercury on zinc, we look with interest to see if Mr. Gordon expresses an opinion on the subject. We find that "It probably acts by coating the zinc and particles of iron alike with one and the same metal," an explanation which we fail to see is any explanation at all.

Mr. Warren De la Rue's battery is fully described. This battery is perhaps one of the best forms possible for laboratory work. It is very compact and cleanly, and, for this reason, is becoming very extensively used for cable testing.

With reference to Grove's battery, it is stated "There is no economy in purchasing small cells, as

with them the acids can seldom be used more than once, whereas, with large ones, they can be used four or five times. 'Quart' cells, with platinums 6 inches by 3 inches, are the best size." This is a useful scrap of information.

The chapter on the Wheatstone bridge contains excellent illustrations of the various forms of apparatus used in connection with it, but in speaking of the "metre bridge," or, as Mr. Gordon calls it, the "sliding bridge," it is stated that it is not susceptible of great accuracy, a statement devoid of fact, as it is the only form of bridge with which accurate measurements of low resistances can be made.

To those who wish for a clear explanation of the adjustment of the B. A. units, we would commend Chapter XXVI., as the explanations are very full and clear.

Part III., vol. 2, deals with electro-kinetics. The chapters in this part are on "Standard Coils," "Diamagnetism and Magno-crystallic action," "The Determination of Equi-potential Lines and Surfaces and Lines of Flow;" these latter experiments, which are very interesting, were made by Professor W. G. Adams, the subject being treated purely experimentally. The chapters on the induction coil and the experiments made with it are very fully illustrated, the beautiful experiments of Messrs. Warren De la Rue and Spottiswoode being shown by coloured plates. Mr. Crooke's experiments are also fully described, indeed are reprinted *verbatim* from the lecture delivered before the British Association in August, 1879.

Messrs. Perry and Ayrton's experiments on contact electricity are also merely reprints from papers by the authors. Concerning this question, it appears to us that the phenomenon of so-called polarisation in batteries has never been explained satisfactorily. The electromotive forces or potentials produced when a single metal is placed in contact with an electrolyte is stated to be definite; now polarisation is said to be due to the development of hydrogen on the surface of the negative element; this produces an opposing electromotive force and reduces the effect. If, then, the electromotive force produced is definite, why does not the potential at the battery poles go down with a jump, as it were, and not go on gradually decreasing as is actually the case? It has been explained that the cause is due to the hydrogen becoming more and more developed, an explanation which is no explanation at all. The hydrogen does become developed, and the electromotive force decreases as this takes place, but why it should do so is not explained. The effect of an opposing electromotive force in a circuit is definite, no matter whether this be produced by a very small battery or by a number of the latter all connected together for quantity. If we consider each bubble of the hydrogen of polarisation to be similar in effect to a small battery, then the first bubble should reduce the electromotive force a step, and all succeeding bubbles should neither increase or decrease this effect.

Perhaps the most novel matter in Mr. Gordon's book is that contained in Part IV., in which the relations between electricity and light or electro-optics are dealt with. The experiments on this subject are highly interesting, and the author has himself verified the results of a number of the researches.

Proceedings of Societies.

PHYSICAL SOCIETY.—JUNE 26th.

Prof. W. G. ADAMS in the Chair.

MR. C. V. BOYS read a paper by Professor GUTHRIE and himself on the measurement of the conductivity of liquids by means of magneto-electric induction. The liquid is suspended in a glass vessel by a fine iron wire in the centre of a cylindrical electro-magnet, formed of two semi-circular parts. This electro-magnet is rotated at a velocity not exceeding 3,000 turns per minute, and the liquid being drawn round in the direction of rotation the wire is subjected to torsion which, under correction for certain errors, is proportional to the resistance of the liquid. The torsion is observed by means of a scale and microscope. The results plotted in a curve agree very closely with those of Kohlrausch obtained by alternate currents, and Dr. Guthrie thinks that they are probably more correct and trustworthy than Kohlrausch's, for the method would seem to be superior and the curve contains fewer eccentric points than his.

Dr. GLADSTONE read a paper on the "Refraction Equivalents of Isomeric Bodies," in which he described the present state of the subject and his own contributions to it. He showed that the refractive power of bodies over light was of great importance to chemists, since it depended on their essential structure.

Dr. HUGGINS described his latest results of star spectra, and illustrated his remarks by photographic spectra, taken by his improved method. From these it appears that certain stars, such as Vega, give a complete spectrum of hydrogen. Others, more yellowish in colour, show a thinning of these lines, such as Sirius, N. Ursæ Majores. Others show the intrusion of more refrangible lines, for example, Arcturus, A. Aquila, L. Virginius, while Capella gives a complex spectrum like that of the sun. Dr. Huggins also showed a spectrum of the flame of a spirit lamp, which presented a strong group of lines at s, and he considered it to represent the light emitted by the molecules of water. He further observed that the spectrum offered a highly sensitive test of the presence of carbon.

Mr. LIVEING exhibited a new fire-damp indicator, capable of detecting a quarter per cent. of marsh gas in air. It is based on the fact that an incandescent body shows more brilliantly in proportion to the amount of marsh gas in the air, and consists of two fine platinum wires kept incandescent by a magneto-electric current sent through them in one circuit. One wire is excluded from the fire-damp, the other is exposed to it, and the relative intensities of the two glowing wires is compared by a photometric screen placed between them and adjustable to a position between them at which the reflections of the wires on the screen are of equal intensity. The position of the screen relatively to the wires is given by a scale, and measures the proportion of fire-damp in the air. This contrivance is more advantageous than the safety lamp, which only indicates two per cent. of marsh gas.

Dr. STONE explained a new vacuum shunt for induction currents, devised by himself and Dr. KEILER. It consists of a mercury barometer tube with Torricellian vacuum and a movable cistern suspended by a cord over a pulley and supported by a counterpoise. By raising or lowering the cistern (which is connected to the tube by an india-rubber pipe) the mercury column is also raised or lowered, and the length of the vacuum, that is, the resistance of the shunt, altered.

Mr. MACFARLANE GRAY read a paper on "Specific Heats calculated from Eutropy." The author arrives at some remarkable results, which will be found in his

paper in the Proceedings of the Society. He also explained a new graphic method of representing eutropy.

Mr. CLARK communicated a paper on the behaviour of liquids and gases near their critical temperature.

Mr. WINSTANLEY exhibited two new varieties of air thermometers and a thermograph, actuated by an air thermometer, on the principle of his radiograph, exhibited at last meeting. The first thermometer consists of a U tube, with terminal bulbs, and the left leg of much finer bore than the right. Mercury is in the right leg, sulphuric acid surmounted with air in the left. The apparatus is a barometer to the air inside the left bulb, and a thermometer to that outside. A similar combination of an air thermometer and an aneroid barometer constitutes the second instrument. The expansion or contraction of the air in the stem by external temperature expands or compresses a small aneroid chamber in the bulb.

Mr. GEE and Mr. STROUD made a communication on a modification of Bunsen's calorimeter, which will be found in the Proceedings of the Society. The meeting then adjourned till the winter session commences.

New Patents—1880.

2387. "Improvements in electric telegraphs and in apparatus connected therewith." Sir C. T. BRIGHT. Dated June 12.

2390. "Improvements in and connected with the working of railway signalling apparatus." G. K. WINTER. (Partly communicated by J. Craik.) Dated June 12.

2392. "Improvements in and relating to the mariner's compass and in appliances for adjusting and correcting the same." D. MCGREGOR. Dated June 12.

2418. "Transmitters for telephones or vocal sound telegraphs." R. M. LOCKWOOD and S. H. BARTLETT. Dated June 15. *(Complete.)*

2432. "Improvements in or relating to ship's binnacles and lamps, part of which invention is applicable to other purposes." J. M. SIM. Dated June 16.

2433. "Apparatus for moving and locking railway points and signals." R. HILL and D. MARLOR. Dated June 16.

2444. "Improvements in fog alarm signals for railways and in attaching fog or alarm signals to the rails of railways." T. JENKINS and W. PRICE. Dated June 16.

2445. "Improvements in floats and in apparatus for indicating the water-level in steam boilers and notifying an undue variation in such level." A. A. DUPONT. (Communicated by J. Bachrich.) Dated June 17.

2453. "Electric apparatus for working railway brakes." J. C. MEWBURN. (Communicated by F. A. Achard.) Dated June 17.

2459. "New applications of electricity for preventing railway accidents and apparatus in connection therewith." A. A. DUPONT. (Communicated by J. Bachrich.) Dated June 17.

2460. "Low-water alarms for steam generators." S. and H. N. BICKERTON and D. ORME. Dated June 17.

2468. "Apparatus employed in telephonic signalling." E. H. JOHNSON. Dated June 18.

2526. "Improvements in or relating to signals for use on railways." E. A. SULLIVAN. Dated June 22.

2539. "Apparatus for operating points and signals on railways." H. JOHNSON. Dated June 22.

2564. "Galvanic batteries." R. C. ANDERSON. Dated June 23.

2567. "Automatic railway signals." L. V. LOYD. Dated June 23.

2597. "Electric batteries." A. V. NEWTON. (Communicated by F. Tommasi.) Dated June 25.

2610. "Telephones or telephonic apparatus." J. H. JOHNSON. (Communicated by F. A. Gower.) Dated June 26.

2643. "Registering apparatus for use in telephone systems or exchanges." J. H. JOHNSON. (Communicated by C. J. Bell and S. Taniter.) Dated June 29.

2665. "Improvements in protective and insulating casings or coverings for underground telegraphic, telephonic, or other wires." W. R. LAKE. (Communicated by R. B. Lamb.) Dated June 29.

2690. "Method of constructing telegraphic, telephonic, and other wires." C. MOSELY, W. F. BOTTOMLEY, W. E. HEYS. Dated July 1.

2710. "Improvements in and connected with telegraph apparatus." C. KESSLER. (Communicated by F. Fuchs.) Dated July 2.

2730. "Automatic electric time signalling apparatus." J. WETTER. (Communicated by W. H. Shuey.) Dated July 3.

2754. "Improvements in signalling upon railways and in apparatus or means for operating signals and other moving points of or connected with railways." S. J. V. DAY. (Communicated by J. S. Williams.) Dated July 6.

2761. "Apparatus for operating railway signals, gates, or similar devices." H. J. HADDEN. (Communicated by J. A. Emery and J. E. Stuart.) Dated July 6. *(Complete.)*

2764. "Improvements in and connected with electric lamps." G. G. ANDRÉ. Dated July 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

4534. "Electric machines." C. W. SIEMENS. Dated November 6. 6d. Relates to means of regulating the working of dynamo-electric and electro-dynamic machines, by causing those of the one class to produce more or less electricity according as more or less is required to overcome varying electrical resistances in their external circuits, and causing those of the other class to produce more or less motive power according as more or less is required to overcome varying mechanical resistances in the machinery which they are applied to work. The amount of resistance in any branch of an electrical circuit is, other things being equal, dependent on the length of conductor constituting that branch, and therefore when a branch forms the coil of an electro-magnet, its resistance is greater the greater the number of convolutions in the coil. On the other hand, the greater the number of these convolutions the greater is the exciting influence of a given current of the magnet. Instead of making the coils of the stationary electro-magnets of the machines as they are usually made, to present an electrical resistance nearly equal to that of the coils of the rotating armatures, their resistance is largely increased, making it amount to not less than ten times that of the armature coils; and this is done by a great increase of the number of their convolutions, so as to give the circuit of each coil a greatly increased length without reducing the sectional area of the wire of which it consists. Also instead of arranging the connections of the coils of the electro-magnets in the usual way, so as to

bring them into the general circuit of the armature and its external field as part thereof, they are arranged so that the increased coils form portion of a branch circuit connected to the external circuit of the machine beyond the commutator.

4555. "Electro-magnets." JOSEPH BELL and GEORGE SCARLETT. Dated November 8. 2d. Consists in winding two or more coils or helices of wire round the same core, or two or more independent wires insulated from each other in the same coils or compound helices. The first plan the patentees prefer, as they find it much easier to insulate the one from the other than when they are intermingled. Usually the insulating bobbin on which they are wound is formed in as many separate divisions as there are wires, a division for each wire, so as effectually to insulate them the one from the other. Thus presuming there are two bobbins, and each bobbin is divided into two parts, there are four helices or coils with eight ends, four from the bottom or beginning of the coils, and four from the top or finish of the same. Now if they are all right-handed or all left-handed coils, the four bottom coils are united to one terminal of the battery or generator of electricity, and the other four to the other terminal of the said battery or generator. The cores are then placed in the centres of the bobbins. It is claimed that a magnet of far superior power is obtained in this way. (*Provisional only.*)

4572. "Conductors or cables for telephonic purposes." W. R. LAKE. (A communication from E. Holmes and E. T. Greenfield.) Dated November 10. 6d. Intended to prevent or eliminate the effect of induction in electric conductors that are arranged in close proximity to each other. It proposes to braid the wires together into a cable, for which purpose they must be properly insulated to prevent contact of the conducting surfaces. By braiding the wires each one of the system will cross and re-cross each and every one of the others, and the construction being uniform throughout, the nodes occurring at regular intervals, and the curves rising to uniform heights from the axial line of the cable, this regularity of construction producing most advantageous results.

4573. "Electric telegraph apparatus." C. D. ABEL. (A communication from Ernst George.) Dated November 10. 8d. Relates to an improved construction of electric telegraph apparatus, wherein a step by step instrument is combined with a type printing apparatus. A type wheel actuated by a crank-handle is moved in accordance with the index actuated from the distant station and situated on the same letter dial as the said crank-handle, the impression of the corresponding types being effected by the lateral motion or shifting of a ring, or wheel-shaped part, when the crank-handle is made to mark the divisions at which the index stops.

4576. "Electric lamps." T. A. EDISON. Dated November 10. 6d. Consists in a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place. Also in placing such a light-giving body in a nearly perfect vacuum, to prevent oxidation and injury to the conductor by the atmosphere. Likewise refers to the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading wires and the carbon conductor.

4589. "Apparatus for generating electric currents," &c. C. F. HEINRICHS. Dated November 11. 2s. Consists in an improvement on the well known Paccinotti armature; a ring armature in channel form being specially claimed. Also in the general construction of apparatus for generating electric currents continuous; or alternating and multiple circuit currents. Likewise in a brush holder and in various forms of lamps, mostly with circular or curved carbons.

4590. "Electric lighting." G. P. HARDING. Dated November 11. 6d. Relates to the position and feed of the carbons or electrodes, and to the relighting of the electrodes when extinguished. The carbons are placed horizontally, preferably one above the other, with a current having the necessary tension to form the arc at the extremities of the carbons. A shunt is arranged to bring the carbons together gradually or otherwise, and this arrangement can be utilised for several other objects. The expansion by heat of a metal bar is used for feeding the carbons as they consume, and sometimes this expansion is carried so far as to fuse the wire and utilise this fusion of wire as a means of bringing into play the advancing the carbons as they consume; in place of wire sometimes stops of wood or glass are used, the heat of the carbon in the latter case softening the glass so as to allow it to bend, and to pass the stop and put the machinery in motion to bring the carbon forward. This expansion or fusion may be equally employed for liberating a weight, or for acting a ratchet or spring, a lever, or a cam, by the aid of which the carbons are fed the given rate, the feed being thus regular and definite.

4593. "Electrical signal or indicator apparatus." WALKER MOSELEY. Dated November 11. 6d. Relates to electrical signal or indicator apparatus, chiefly designed to be used in connection with an electrical bell, the purpose of the said apparatus being to indicate the room or apartment from which the bell has been rung, or to convey signals of various kinds, as may be desired.

4599. "Insulated electric conductors." J. BELL. Dated November 8. 6d. Asbestos or amianthus paper is wrapped, spirally or otherwise, around the metallic conductor, and secured by any suitable adhesive agent. The same is then plaited or braided with asbestos or amianthus fibres or thread, afterwards being passed through pulped asbestos or amianthus, then surrounded with asbestos or amianthus, wrapped spirally or otherwise, and finally coated with silicate of soda or other agent to bind the whole and withstand moisture.

4613. "Needle sounder for electric telegraph instruments." F. M. ROGERS. Dated November 13. 6d. Intended to enable the ordinary needle telegraph instrument to appeal to the ear as well as to the eye of the operator. (*See* TELEGRAPHIC JOURNAL, Vol. VIII., p. 133.)

City Notes.

Old Broad Street, July 13th, 1880.

THE EASTERN TELEGRAPH COMPANY, LIMITED.—The report of the directors to be presented to the sixteenth ordinary general meeting states that the Company's revenue for the six months ended 31st March, 1880, amounted to £291,194 16s. 2d., from which is deducted £68,637 18s. 8d. for the ordinary expenses of the Company, and £19,896 11s. 9d. special expenditure during the half-year and £1,990 10s. 2d. for income

tax, leaving £200,660 15s. 7d., which, together with £15,279 8s. 7d. brought forward from the preceding half-year, gives a balance of £215,940 4s. 2d. From this balance, £22,347 12s. 4d. has been paid for interest on debentures, and £20,561 18s. for dividend to 31st March, 1880, on the preference shares. The directors have during the half-year paid an interim quarterly dividend of 1¼ per cent. on the ordinary shares. They now recommend the declaration of a final dividend for the year ended 31st March, 1880, of 2s. 6d. per share, payable on the 16th instant, making, with the three previous payments on account, a total dividend for the year of 5 per cent. on the ordinary shares, and that the balance, £78,205 13s. 10d. be carried to the reserve fund, which will then amount to £262,849 3s. 3d. The steamship *Chiltern* is engaged in restoring communication by the duplicate cable from Vigo to Lisbon. With the exception of this section the Company's cables are all in good working order. The other repairing ships are stationed in the Red Sea and Mediterranean fully equipped in readiness for the Company's requirements. The directors have from time to time received applications for assistance to the relatives of deceased members of the staff, and for the relief of those becoming incapacitated through illness from performing their duties. With the view of meeting such cases for the future, and encouraging the employés of the Company to make provision for the risks to which many of them are especially exposed in the climates where they are necessarily stationed, the board has, subject to the approval of the shareholders, made arrangements by which the Company's officers can secure the payment to themselves of a limited sum at a fixed age, or to their relatives in case of death, the Company paying half the premiums required. It is estimated that if this plan is availed of by the employés generally, the cost to the Company will be about £2,500 per annum. A resolution authorising the directors to carry out this arrangement will be submitted to the meeting. Since the last general meeting the directors have issued 9,600 ordinary shares, and with the proceeds purchased for the Company 9,500 fully paid shares of the Eastern and South African Telegraph Company. They have also provisionally taken, for £95,000 cash, a further 9,500 of those shares, with the dividend accrued thereon since that company's line was opened and established. The returns from the line, during the past six months, have been sufficient to pay a dividend for that period, at the rate of 6 per cent. per annum on the entire share capital, after discharging all working expenses, interest, and amortisation of debentures, and making a substantial reserve for repairs and renewals. The directors are of opinion that the acquisition of the above shares—which, with those already held, will give to this Company £390,000 out of the total share capital of £400,000—is a decided advantage to the shareholders. The meeting will be asked to sanction the payment of the £95,000 for the purpose mentioned. It is proposed for the present to provide the amount required, partly out of the current balances, partly by loans for short periods, and the remainder by the temporary application for that purpose of a portion of the reserve fund; the intention of the Board being to replace all such advances when the renewal or re-arrangement of the debenture debt of the Company is effected. The meeting will take place on the 15th instant at the Terminus Hotel, Cannon Street, at two o'clock.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.—The report of the directors for the half-year ending 30th June, 1880, to be presented at the eighteenth ordinary general meeting of shareholders states, that the the gross receipts for the half-year ended 30th June last, including the balance brought from last account, amount to £20,562 4s. 1d., and the gross expenditure to £3,718 3s. 9d., leaving a sum of £16,844 0s. 4d. to the credit of revenue account. Of this, the sum of £4,300 has been placed to the reserve fund, increasing that fund to £32,063 13s. 10d. After providing for the Preference dividend, a balance of £9,544 0s. 4d. remains, out of which the Directors recommend the payment of a dividend on the Ordinary Shares at the rate of 7 per cent. per annum, which will absorb £5,600, and leave £3,944 0s. 4d. to be carried forward to the current half-year's account to meet the cost of the repair of the Cienfuegos-Santiago section of the original cable. The directors regret to report that this section, which the shareholders will recollect was repaired in November last, again gave way in March. Mr. Keith, the Company's engineer, is now engaged in the work of repairing it, intelligence of the completion of which may be received at an early date. It will be satisfactory to the shareholders to learn that the Company's other cables continue in good working order. The director who retires from the Board at this time is Mr. Thomas Hughes, who, being eligible, offers himself for re-election. Mr. James Cowan, the auditor, also retires, and offers himself for re-election. The meeting will be held at the Company's offices, No. 61, Old Broad Street, on the 21st inst., at two o'clock.

AT a board meeting of the Direct United States Cable Company (Limited), it was resolved to recommend a final dividend of 5s. per share, such dividend to be payable on and after the 16th August next, making, with the interim dividends already paid, 5 per cent. for the half-year ending 30th June last, carrying forward £21,760, after having carried to the reserve fund £22,847, making it up to £175,000.

The following are the final quotations of telegraphs.—Anglo-American Limited, 62⅝-63; Ditto, Preferred, 93½-94½; Ditto, Deferred, 34½-35; Black Sea, Limited, ——; Brazilian Submarine, Limited, 8⅛-8½; Cuba, Limited, 9⅝-10; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1⅞-2⅛; Direct Spanish, 10 per cent. Preference, 11-11½; Direct United States Cable, Limited, 1877, 11½-11⅝; Scrip of Debentures, 102-104; Do., £50 paid, 1-3; Eastern, Limited, 9⅛-9⅜; Eastern 6 per cent. Preference, 12⅛-12⅜; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 105-108; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 9⅛-9⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 102-104; Ditto, registered, repayable 1900, 102-105; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 100-102; Ditto, ditto, to bearer, 100-102; German Union Telegraph and Trust, 9-9½; Globe Telegraph and Trust, Limited, 6-6½; Globe, 6 per cent. Preference, 12-12½; Great Northern, 9⅛-9⅜; Indo-European, Limited, 23-24; London Platino-Brazilian, Limited, 3⅞-4⅛; Mediterranean Extension, Limited, 2⅞-3⅛; Mediterranean Extension, 8 per cent. Preference, 10⅞-11; Reuter's Limited, 9½-10½; Submarine, 240-250; Submarine Scrip, 2⅛-2½; West Coast of America, Limited, 1⅞-2⅛; West India and Panama, Limited, 1½-1⅝; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6½-7; Western and Brazilian, Limited, 6-6¼; Ditto, 6 per cent. Debentures "A," 100-103; Ditto, ditto, ditto, "B," 97-100; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 34½-35; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates, 3⅛-3½; India Rubber Company, 15-15½; Ditto 6 per cent. Debenture, 105-107.